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71 Applicant: THE ELECTRICITY COUNCIL  
30 Millbank  
London, SW1P 4RD(GB)

72 Inventor: Baker, William Percival  
2 Mayfield View  
Lymm Cheshire(GB)

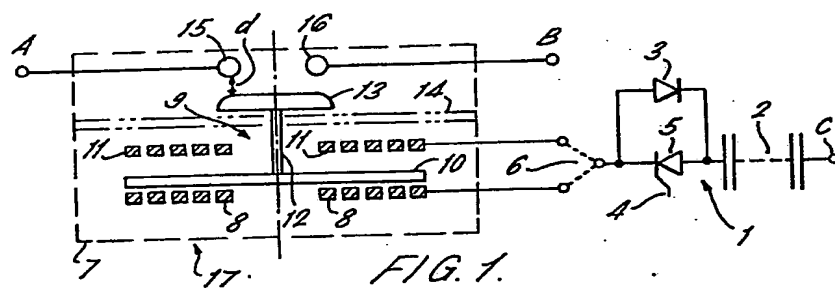
72 Inventor: Fletcher, William Henry  
27 Meadows View  
Marford Wrexham Clwyd(GB)

74 Representative: Cross, Rupert Edward Blount et al,  
BOULT, WADE & TENNANT 27 Farnival Street  
London EC4A 1PQ(GB)

54 Circuit breaker assembly.

57 A circuit breaker assembly for breaking an alternating current path between terminals A and B comprises a double break contact bridge 13 movable from a contacting position to a circuit breaking position to provide a gap d between the contact surfaces. A stub member 12 connects the contact bridge to a substantially planar disc 10 disposed between a substantially planar spiral coil 11 and 8.

A source of current suitable for energising the coils 11 or 8 is connected via switch 6 and triac 5. By suitable arrangement of the switch 6 and application of a pulse to the control terminal 4 of the triac 5, it is possible to achieve a rapid opening or closing of the circuit breaker assembly.



CIRCUIT BREAKER ASSEMBLY

This invention relates to circuit breaker assemblies for breaking a current path.

5       Known circuit breakers include a pair of contacts connectable by a contact bridge. Typically the contact bridge includes a spring toggle arrangement having a dead centre which is adapted to require only a small initial movement to cause the  
10       bridge to move from a contacting position to a circuit breaking position and to provide a pre-determined insulation gap between the contacts. Known arrangements for causing this small initial movement  
15       comprise a disc of conducting material connected to the bridge and a planar winding to cause the disc to move to provide the small initial movement. Such circuit breakers frequently have the insulation gap immersed in a gas having a dielectric strength greater than air.

20       Unfortunately circuit breaker assemblies as described above are relatively slow so that even if an arc reducing arrangement is employed on the circuit

breaker assembly, sparking can still occur resulting in decomposition of the gas and damage to the contacts and the contact bridge. In order to reduce these problems a large insulation gap is frequently provided.

5           It is an object of the invention to provide a circuit breaker assembly having rapid separation of contacts and contact bridge within one half cycle of mains frequency.

10           According to the invention there is provided a circuit breaker assembly for breaking an alternating current path comprising: a circuit breaker having an armature movable from a contacting position to a circuit breaking position providing a predetermined insulation gap between contacts, a planar element of  
15           conducting material arranged on the armature transversely of the direction of movement, a planar coil disposed to repel said element when energised to move the armature to the circuit breaking position; and trigger means to energise the coil.

20           By providing a planar coil to repel the planar element to cause the armature to move to the circuit breaking position, it is possible to achieve a rapid opening of the circuit breaker assembly so that rapid separation of contacts and armature are achieved within  
25           one half cycle of mains frequency. The rapid separation substantially reduces the incidence of

arcing and hence damage to the armature and contacts. In addition, since separation is achieved rapidly the insulation gap can be reduced thereby allowing a smaller construction of circuit breaker assembly.

5            Preferably the circuit breaker assembly includes a diode arrangement connected in parallel with the circuit breaker to provide a short circuit during half cycles of the alternating current having one polarity, and further including another said circuit breaker  
10 connected in series with said diode arrangement and first mentioned circuit breaker and having its coil also energisable by said trigger means, the trigger means being capable of energising the first mentioned  
15 breaker coil during said half cycles and of energising said another breaker coil during half cycles of the alternating current having the other polarity. In this way a substantially arc free circuit breaker assembly is provided. The first mentioned circuit  
20 breaker is disconnected when it is short circuited by the diode arrangement and the another circuit breaker is disconnected during the following half cycle of the alternating current when the first mentioned circuit breaker is not short circuited.

25            Conveniently the trigger means comprises an analogue switching device for connection to a source of coil energising current and having a control

terminal for altering the state of the device to control flow of the energising current. When two circuit breakers are employed the trigger means preferably comprises first and second analogue  
5 switching devices for connection to a source of coil energising current, the first switching device being connected to energise the coil of the first mentioned circuit breaker and the second switching device being connected to energise the coil of said another  
10 circuit breaker, each switching device having a control terminal for altering the state of the device to control flow of the energising current.

Furthermore it is preferable that the circuit breaker assembly is arranged to have the mentioned  
15 circuit breakers including a further planar coil disposed to repel the planar element when energised to move the armature to the contacting position and wherein the trigger means is adapted to energise either coil of the respective circuit breaker. In  
20 this way once a circuit breaking position has been assumed by the armature it is possible to move the armature back to its contacting position, effectively resetting the circuit breaker assembly.

Conveniently the insulation gap is provided  
25 within a vacuum or else provided within a fluid having a dielectric strength greater than air and a

viscosity less than water. The fluid can comprise sulphurhexafluoride. The insulation gap can also be reduced when compared with circuit breaker assemblies hitherto known and preferably has a dimension of 6 mm.

5 The armature can also comprise a double break contact.

Examples of the present invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 illustrates a circuit breaker  
10 assembly embodying the invention;

Figure 2 illustrates a further circuit breaker assembly embodying the invention which includes two circuit breakers.

Referring to Figure 1, a circuit breaker  
15 assembly comprises a circuit breaker 17 connected to a trigger means 1. The circuit breaker 17 having a double break contact bridge 13 movable to a contacting position to complete a circuit between contacts 15 and 16, the contacts being connected to  
20 terminals A and B respectively. An alternating current C of frequency F is applied to terminal A and when contact bridge 13 is in the contacting position a current path is provided to terminal B. The contact bridge is also movable to a circuit breaking  
25 position wherein a gap d exists between the Bridge and contacts 15 and 16.

The armature comprises the contact bridge 13 connected by a stub member 12 to a substantially planar disc 10 of conducting material arranged transversely of the movement of the bridge and hence the armature.

5 A substantially planar spiral coil 11 is disposed substantially parallel to the disc 10 to be capable of repelling the disc when energised to move the armature to its breaking position wherein the bridge 13 is out of contact with contacts 15 and 16.

10 The coil 11 is connected through switch means 6 to the trigger means 1. The trigger means comprises a triac 5 connected in series between the switch means 6 and capacitors 2. The capacitors 2 are connected to a source of current suitable for energising coil 11.

15 A diode 3 is connected in parallel with triac 5. When a pulse is provided to a control terminal 4 of the triac 5 to cause it to assume a closed circuit state, power from terminal C, preferably having a high frequency impulse energy, energises coil 11 to cause  
20 the armature to move so that it assumes a circuit breaking position.

Therefore by applying a pulse to control terminal 4 the armature 9 is moved substantially completely into its circuit breaking position. If  
25 resetting of the circuit breaker assembly is required, a further coil 8, similar to coil 11, can be disposed



to repel disc 10 when energised so that the armature 9 assumes its contacting position. The gate means 6 can be arranged to control energisation of either coil 8 or 11.

5            Preferably the gap d being an insulation gap is of the order of 6 mm and the volume indicated by line 7 can either be evacuated or can be immersed in a fluid having a dielectric strength greater than air and a viscosity less than water. It is found that an  
10 insulation gap of 6 mm and immersion in sulphurhexafluoride at 3 atmospheres has an impulse strength of 90 KV and complete movement of the armature is achieved within 3 milliseconds, which is less than one half cycle of mains frequency.

15            The pulse that is applied to control terminal 4 can be derived from logic circuits detecting an overload current.

Referring to Figure 2, components common to Figure 1 have the same identifying numerals. The  
20 circuit breaker 17 has a diode arrangement 20 connected in parallel therewith and a further circuit breaker 17', identical to circuit breaker 17, is connected in series with the diode arrangement 20 and circuit breaker 17. The circuit breaker 17' is  
25 connected to a further trigger means 1' identical to trigger means 1.

Therefore when the armature 9 and 9' of circuit breakers 17 and 17' respectively are in their contacting position, a current path for alternating current of frequency  $f$  is provided between terminals A and B. When circuit breaking of the assembly in Figure 2 is required in response to an overload current, external logic detects when diode arrangement 20 is forward biased and hence short circuiting circuit breaker 17, a control pulse is applied to control terminal 4 of triac 5 to allow energising power from capacitors 2 to energise coil 11 to move armature 9 to its circuit breaking position. When the external logic detects when diode arrangement 20 is next reversed biased so that point C is electrically isolated from terminal A, then a control pulse is applied to control terminal 4' of triac 5' to allow energising power from capacitors 2' to energise coil 11' to move armature 9' to its circuit breaking position.

Consequently the circuit breaker assembly illustrated in Figure 2 breaks the circuit from terminals A to B without a spark since the actual movement from conducting to circuit breaking positions is achieved within half cycles of the frequency  $f$  during which the diode arrangement is either forward or reversed biased. Preferably the volumes 7 and 7'

are immersed in sulphurhexafluoride gas to provide an increased impulse strength across the insulation gap of the respective contact breakers 17 and 17'. By including coils 8 and 8' and suitable operation of the gate means 6 and 6', the circuit breaker in Figure 2 can be reset so that the armatures 9 and 9' are in their conducting positions.

Therefore the circuit breaker assembly shown in Figure 2 prevents arcs and consequently the properties of the sulphurhexafluoride gas remain constant in addition to which the dielectric strength thereof remains stable. It will be apparent that trigger means other than those illustrated can be employed to energise the coils of the circuit breaker 17 and can include analogue switches other than triacs. Although the contact bridge 13 is illustrated as a double break contact the invention is not limited to the use of double break contacts.

CLAIMS:

1. A circuit breaker assembly for breaking an alternating current path comprising:-

5 a circuit breaker having an armature movable from a contacting position to a circuit breaking position providing a predetermined insulation gap between contacts,

10 a planar element of conducting material arranged on the armature transversely of the direction of movement,

a planar coil disposed to repel said element when energised to move the armature to the circuit breaking position; and

15 trigger means to energise the coil.

2. A circuit breaker assembly as claimed in claim 1 including a diode arrangement connected in parallel with said circuit breaker to provide a short  
20 circuit during half cycles of the alternating current having one polarity, and further including another said circuit breaker connected in series with said diode arrangement and first mentioned circuit breaker and having its coil also energisable by said trigger  
25 means, the trigger means being capable of energising the first mentioned breaker coil during

said half cycles and of energising said another  
breaker coil during half cycles of the alternating  
current having the other polarity.

5           3.       A circuit breaker as claimed in claim 1  
wherein said trigger means comprises an analogue  
switching device for connection to a source of coil  
energising current and having a control terminal for  
altering the state of the device to control flow of  
10 the energising current.

          4.       A circuit breaker assembly as claimed  
in claim 2 wherein said trigger means comprises first  
and second analogue switching devices for connection  
15 to a source of coil energising current, the first  
switching device being connected to energise the  
coil of the first mentioned circuit breaker and the  
second switching device being connected to energise  
the coil of said another circuit breaker, each  
20 switching device having a control terminal for  
altering the state of the device to control flow of  
the energising current.

          5.       A circuit breaker assembly as claimed  
25 in any one of claims 1 to 4 wherein mentioned circuit  
breakers include a further planar coil disposed to

repel the planar element when energised to move the armature to the contacting position and wherein the trigger means is adapted to energise either coil of the respective circuit breaker.

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6. A circuit breaker assembly as claimed in any one of claims 1 to 5 wherein said gap is provided within a vacuum.

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7. A circuit breaker assembly as claimed in any one of claims 1 to 5 wherein said gap is provided within a fluid having a dielectric strength greater than air and a viscosity less than water.

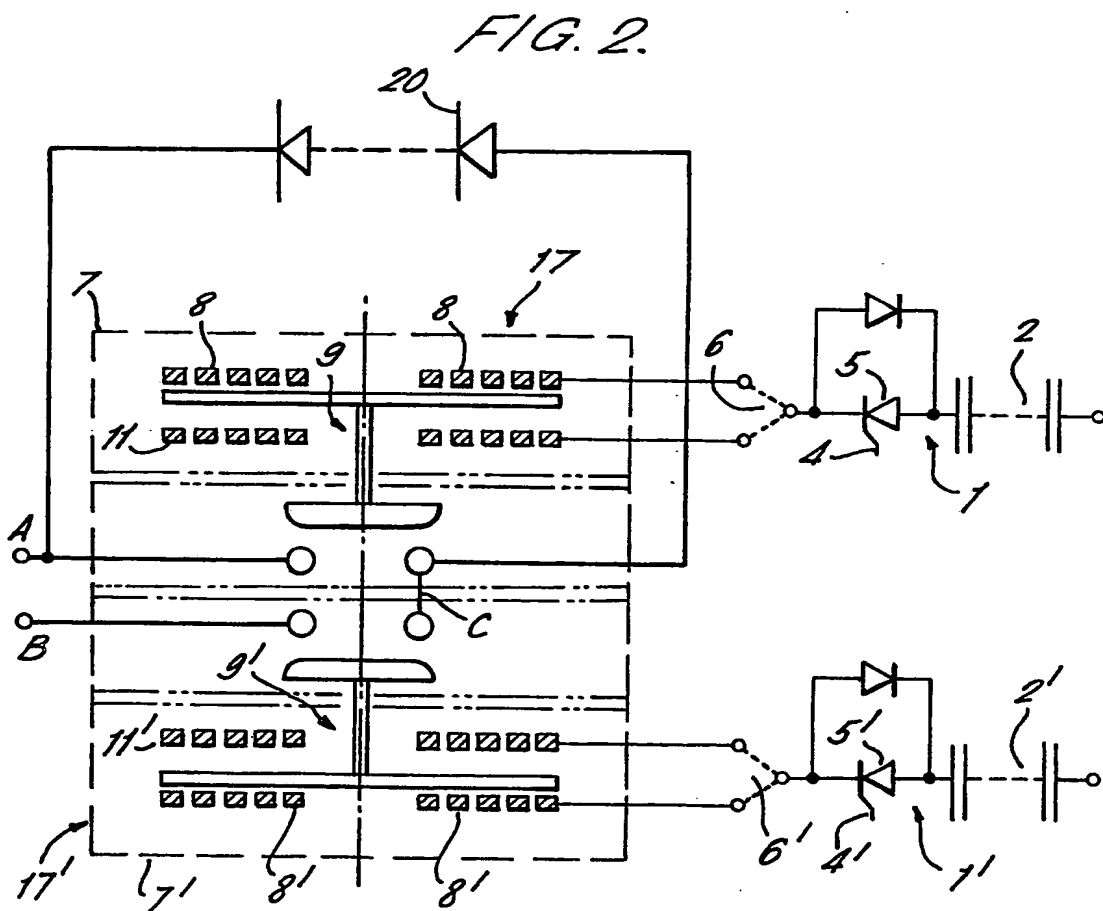
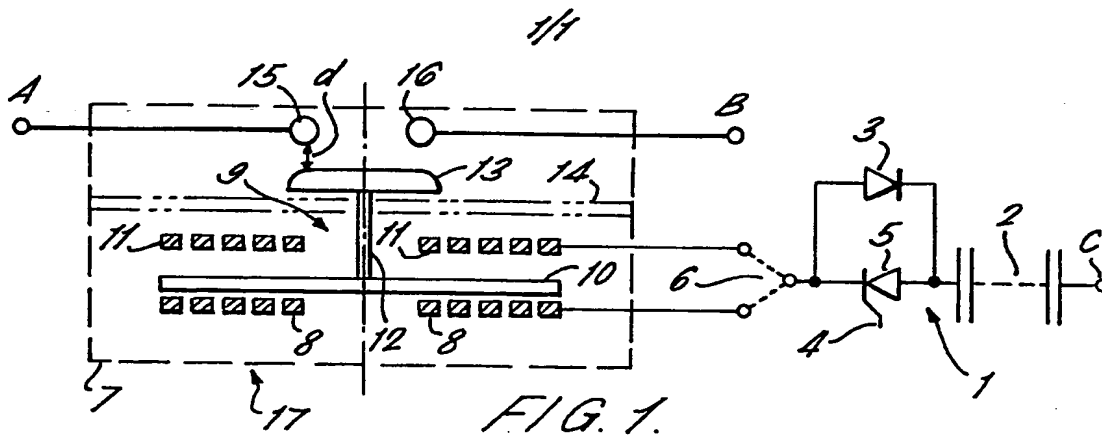
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8. A circuit breaker assembly as claimed in claim 7 wherein said fluid is sulphurhexafluoride.

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9. A circuit breaker assembly as claimed in any one of claims 1 to 8 wherein said insulation gap is approximately 6 mm.

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European Patent  
Office

# EUROPEAN SEARCH REPORT

0147036

Application number

EP 84 30 7618

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	US-A-3 764 944 (CLIFFORD) * Column 3, line 58 - column 4, line 41; figures 1,2 *	1,3,5,6	H 01 H 33/28 H 01 H 9/54
Y	---	2,4	
Y	FR-E- 78 480 (C.G.E.) * Page 2, line 47 - page 3, line 37; figures 1,3 *	2,4	
A	FR-A-2 333 338 (MERLIN GERIN) * Page 5, lines 10-25; figure 2 *	7-9	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
			H 01 H 9/00 H 01 H 33/00
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 08-03-1985	Examiner TOUSSAINT F.M.A.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	